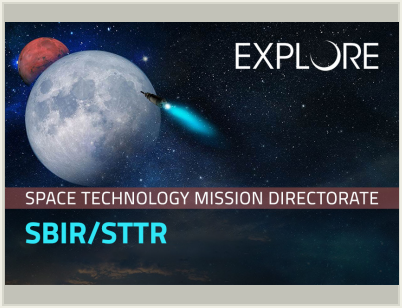
Next Generation Gamma/Neutron Detectors for Planetary Science., Phase I

Completed Technology Project (2012 - 2012)

Project Introduction

Gamma ray and neutron spectroscopy are well established techniques for determining the chemical composition of planetary surfaces, and small cosmic bodies such as asteroids and comets; however, new technologies with the potential to significantly improve the performance of planetary nuclear spectroscopy are emerging in response to demands in other fields such as homeland security. We propose to develop new gamma-ray and neutron detectors based on wide-band-gap solid state photomultiplier (SSPM) photodetectors coupled to emerging scintillation materials such as Cs2YLiCl6:Ce (CLYC), and CeBr3 for gamma and neutron spectroscopic studies of planet surfaces and small cosmic bodies. CLYC is most promising for neutron spectroscopy and can provide high efficiency detection of thermal and epithermal neutrons. In addition, it has excellent pulse height resolution for gamma ray spectroscopy. CeBr3 is also well suited for precision gamma ray spectroscopy. Its extremely high light output, excellent energy resolution, as well as zero self activity, can enable precise measurements of geochemically-significant elements. The proposed SSPM photodetector for scintillation readout is based on AlGaAs, a wide-band-gap compound semiconductor with aluminum concentration between 60% to 90%. The band-gap energy of this material is engineered to provide high photo sensitivity between 300nm to 500nm, which matches well with the emission spectrum of both CLYC and CeBr3. The wide-band-gap nature of AlGaAs also provides much lower dark noise and better radiation tolerance than Si-based detectors. Compared to conventional PMTs, the compact size, low voltage operation, and lighter weight of AlGaAs SSPM is more ideal for spaced based instruments. The advantages of AlGaAs-based SSPM and the excellent detection properties of CLYC and CeBr3 scintillation materials make them a perfect match in the development of next generation gamma neutron spectrometers for planetary science.



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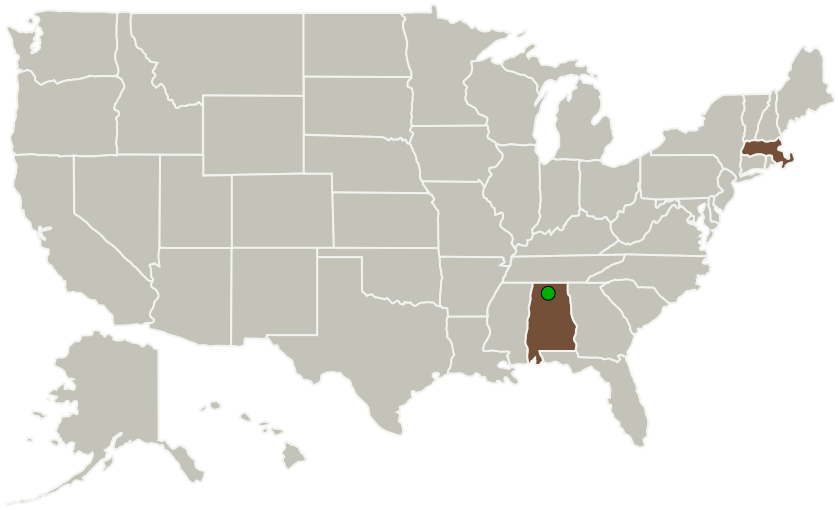
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Radiation Monitoring Devices, Inc.	Lead Organization	Industry	Watertown, Massachusetts
Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	Massachusetts

Project Transitions

February 2012: Project Start

August 2012: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140328)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Radiation Monitoring Devices, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

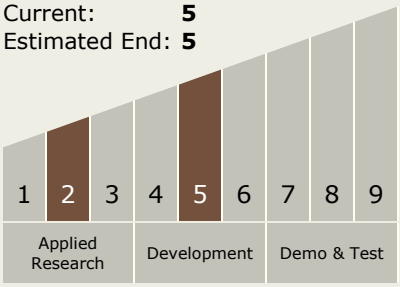
Carlos Torrez

Principal Investigator:

James Christian

Technology Maturity (TRL)

Start: **2**
Current: **5**
Estimated End: **5**



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Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System